INVESTIGATION OF THE ROLE OF ASPEN STANDS FOR CONTROLLING WATER POLLUTION FROM RECREATION AREAS

Final Report

Interim Completion Report May 28, 1981

Project: Investigation of the Role of Aspen Stands for Controlling Water Pollution from Recreation Areas

Contract No: RM-80-106-6R (VEC-353)

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This interim Completion Report is prepared in two chapters. One details the project, site description, objectives, field measurements, laboratory analyses, and vegetation. This chapter does not report any results but only the methodology used. The results will be incorporated into the final report for the project, "Effectiveness of Aspen Stands in Protecting Stream Water Quality from Recreation-Related Pollutants," RM-81-164-6R, now in progress.

The second chapter, an edited version of the report by research assistant Anne Ketchin, describes the results of a recreation activity survey conducted in the study area during the summer of 1980. This report will only be supplemented by observations to be made under the second project.

For this reason, it is submitted in its entirety at this time, but it, also, will be incorporated in the Final Report of the "Effectiveness of Aspen Stands in Protecting Stream Water Quality from Recreation-Related Pollutants," project.

Prepared by J. Ernest Flack,
Principal Investigator

Chapter 1

STUDY SITE DESCRIPTIONS AND METHODOLOGIES

Introduction

The Indian Peaks Wilderness area of the Front Range of Colorado has in recent years come under increasingly heavy impact by recreationalists. This is especially true for a few selected camp sites that are readily accessible. Concern has arisen over possible detrimental effects on the quality of the surface water in the area due to this increased recreational activity from camping, trail use, and car traffic. Aspen are found along many of the water courses, and in or near some of the heavily used recreation sites. It is hypothesized that the aspen may play an important role in controlling water-borne pollution, in controlling recreational activity and in helping maintain a high quality water. See Figure I at the end of this chapter.

Previous Studies

The sensitivity of water quality to recreational activities in relatively pristine mountainous areas has not been studied to a great extent in Colorado. The studies which have been done, however, are significant.

Ponce and Gary (1979) studied the effect of lake-based recreation and second home use on surface water quality in the Manitou Experimental Forest of Colorado, and found no significant degradation of water due to fishing, picnicing, and the use of sealed-vault outdoor toilets. Increased total coliform, fecal coliform, suspended solids, and orthophosphate concentrations were found in some locations and were thought to be the result of poor siting of second homes.

In Utah, increases in fecal coliform counts were found to coincide with peak recreational use (Johnson and Middlebrooks, 1975). Aukerman and

Springer (1976) found small increases in fecal coliform counts in areas accessible by paved roads in Colorado, and Buckler and Utter (1975) found sewage disposal facilities in developed recreation areas in Arizona to be the most prominent source of water pollution.

Lewis and Grant (1979) analyzed the relationship of stream discharge to the concentration of dissolved substances in stream water within Como Creek of the Indian Peaks Wilderness area. Their study showed a varying response of dissolved substance concentration to discharge, sometimes increasing proportionally with discharge, sometimes remaining the same, and sometimes decreasing with the discharge rate.

Lewis and Grant (1980), again working within Como Creek, analyzed the yield of dissolved materials during the low-flow season, under varying snowpack conditions. It was found that during a very low snowpack and high soil frost activity year, there was a dramatic increase in nitrate yield, resulting in much higher nitrate concentrations in streamwater.

Zimmerman (1979) investigated resort-recreation areas in Colorado to determine the effects that wastewater treatment plan effluents have on small, high mountain streams. Significant increases were found in the concentration of phosphates, nitrates and total ammonia immediately below the effluent discharge points. Additionally, decreases were noted in the quality of the communities below the discharge points (probably due to residual chlorine). The streams rapidly returned to their upstream condition with distance downstream.

Objectives

It has been the purpose of this research to determine the quality of the surface waters within selected, highly impacted, recreation areas of the

eastern slope of the Indian Peaks area. It was deemed necessary, in meeting this objective, to identify the significant water pollutants, locate the sources of the pollutants, and assess the magnitude of their impact on the area's water quality. At each study site water samples were collected and tested for bacteriological and chemical pollutants. See Figure 1 for map giving location of study sites. Bacteriological tests were made for fecal coliform and fecal streptococci. Chemical analyses included testing for COD, BOD, nitrogen and phosphorus compounds, grease, oil and lead. Additionally, the water was sampled for total dissolved and suspended solids.

Guidelines are suggested towards the development of a working management plan in order to assure a high water quality within the Indian Peaks Wilderness area. Guidelines are developed for the adequate management of recreational sites as related to the maintenance of water quality and the role that aspen play in helping maintain water quality.

Study Area

Local Characteristics

The study area is within and contiguous to the Indian Peaks Wilderness area of the Front Range of Colorado. This area is located 35 km northwest of Denver and lies immediately south of the Rocky Mountain National Park. Geologically, the main rock of the Indian Peaks area is composed of a core of acidic Precambrian intrusives, intruded by acidic Tertiary plutons (Ives, 1980). A major north-south trending crestline bisects the Indian Peaks area and the Front Range, forming the Continental Divide. The physique of the area has been shaped through a combination of fluvial and glacial erosion (Burns, personal communication).

The vegetation of the Indian Peaks area, as viewed from the air, displays a series of semi-parallel vegetational belts, strongly influenced by the progressive shift in climate belts with increasing altitude (Ives, 1980). The four major vegetational belts with increasing altitude are the Ponderosa pine and Douglas Fir belts, a lower montane forest of Lodgepole pine, Ponderosa pine with some Douglas fir, an upper montane forest of Engelmann spruce and Subalpine fir, and an alpine tundra belt.

Lodgepole pine and Quaking aspen are found interspersed throughout the lower and upper belts, being successive to disturbances, especially to fire. Quaking aspen and willow are found in extensive stands in moist meadows and along streamsides. The density of a Quaking aspen stand, as well as its rich understory appear to persuade campers not to establish campsites within the groves. In contrast the Lodgepole pine, Engelmann spruce and Subalpine fir, in open stands, often provide a more park-like locale which appears to be more conducive to camping and recreational activities.

The small scale distribution of the Quaking aspen within the Indian Peaks Wilderness Area is shown on Figure 2.

The vegetation composition of each specific study site is shown on Figures 3 through 6.

Dominant tree species within the study area include Quaking Aspen (Populus tremuloides), Engelmann spruce (Picea engelmannii), Subalpine fir (Abies lasiocarpa), Lodgepole pine (Pinus contorta), and Limber pine (Pinus flexilis). Shrub species include Willow (Salix spp.), Birch (Betula glanulosa), and Alder (Alnus tenufolia). Understory herbs, forbs, and grasses are numerous within the forested areas, and along the streams, and are listed in the appendix. Vegetation coverage at each specific sampling site within a 10 m plot along both sides of the stream is shown in Table 1.

Recreationalists from the greater metropolitan Denver area and many visitors from out-of-state frequent this area. Recreational activities include car-camping, backpacking, day-hiking, fishing, horseback riding and non-motorized boating.

Study Descriptions

This study has focused on four streams located on the eastern slope of the Indian Peaks area. Three of the streams are impacted by recreationalists whereas one stream has no recreational impact. The study area locations are shown on Figure 1. From each study area, samples of water were collected from a non-polluted, upstream source; at numerous specific sites along the stream section impacted by recreation; and at a site below the recreational area.

1) Boulder City Watershed - The Boulder City Watershed area is closed to public access and therefore, receives no recreational impact, and was used as the control. This area does have a large elk herd during the summer season which may contribute to bacteriological water pollution. Permission to collect samples was granted by the City of Boulder. Discharge of North Boulder Creek, eminating from Silver Lake in the watershed, was measured by Mr. Tom Platt, manager of the watershed.

Site 1A - Site 1A, located at approximately 2910 m (9,720 ft) elevation is 20 yards into the Boulder City Watershed from the entrance gate along the Rainbow Lakes road. The stream includes all discharge from the watershed, and is actually the overflow from water directed to the City of Boulder at a site upstream. Discharge at this site can therefore be variable, but for most of the summer is fairly constant. Although public access is forbidden

in the area, a small work crew does spend the summer in the watershed. Their impact on stream pollution is considered negligible. A fairly large herd of elk spends the summer within the water shed. Although their migration habits take them near the streams, they spend a major portion of the summer above timberline on a ridge locally termed Middle Ridge (on Mt. Albion), between the two major drainages of the watershed. Bacteria may be present in the water system due to the elk or the other fauna such as marmots, pika, deer, rodents, etc. There is a moderate amount of algae growth on the stream sides at this site.

Site 1B - Site 1B is located on the stream at the spillway of Silver Lake, the major reservoir of the Boulder Watershed. Because it is assumed that any pollutants from elk, etc. are settled out of the water within Silver Lake, this site provides an indication of the pollution eminating from a relatively clean lake. The water moves here at a high velocity and discharge measurements made by Mr. Tom Platt were collected at this site. There is a moderate to small amount of algae growth along the banks of this stream. Site 1B is at 3055 m (10,200 ft) elevation.

Site 1C - Site 1C is located at 3080 m (10,280 ft) elevation on North Boulder Creek as it enters Silver Lake. This site was sampled in hopes of isolating any pollutants from the elk herd which lives during the summer on the Mount Albion Ridge to the west of the creek.

2) Rainbow Lakes Campground - The Rainbow Lakes Campground is smaller in area than Brainard Lake Campground and, having a rough dirt road by which to travel, receives relatively fewer numbers of recreationists than the Brainard Lake Campground. Activities within this campground include hiking, fishing, backpacking, and car-camping. No running faucet water is provided

for camper-use at this campground.

Site 2A - Site 2A is located approximately one mile east of the Rainbow Lakes Campground, along Caribou Creek which joins the stream originating from the Rainbow Lakes. Access to this site is along a 4-wheel drive road heading in a south to southeast direction from the Rainbow Lakes road. Campers frequent this site as a large meadow exists near the stream for car-camping, and fishermen gain easy access to the stream. Much of the meadow shows heavy impact in the form of trampling, denuded ground, eroded soil and fire-rings. Tire tracks are seen crossing the stream and as a result, the stream water is often muddy and polluted. Grease and oil from vehicles may very well enter the water at this point. Throughout the entire distance upstream of Site 2A many campsites are found, accessible by both cars and foot travel. Site 2A therefore receives any pollutants from heavy recreational activity upstream. Site 2A is at 2830 m (9,440 ft) elevation.

Site 2B - Site 2B is located within or along the side of the Rainbow Lakes Campground at 2980 m (9,960 ft) elevation. The dirt road leads to a small parking area for fishermen near the campsites, and Site 2B is immediately to the south from this parking lot. There is much activity at this stream side. Campers collect all their drinking and washing water from this area of the stream as no water is provided from faucets within the campground. Campers have been observed washing both dishes and themselves near Site 2B. Additionally, fishermen heavily trample the stream side vegetation and much trash from all types of recreation ist is found both within and along the stream. Dust from traffic on the nearby road may also pollute the waters. Stream discharge was measured at Site 2B.

Site 2C - Site 2C is located at the source of the stream. At 3233 m (10,800 ft) the water eminates from a large perennial snowbank on the east-facing slope of Caribou Mountain, and percolates through a boulder field before surfacing. Recreational activity at this site is minimal although marmots and pika may frequent the area. This site was chosen as a "clean-water" source for Rainbow Lakes Campground.

Site 2D - Site 2D, located at the inlet to the second lake along the Rainbow Lakes trail at approximately 3040 m (10,160 ft) elevation. Along this trail camping is heaviest immediately above Site 2D, and around the third lake. Fishermen frequently visit the stream section above Site 2D.

3) Brainard Lake Campground - Brainard Lake Campground is a major recreational area within the Indian Peaks Wilderness area. A paved road leads to a large car-camping area and to parking that provides easy access to the alpine area for backpackers. Large numbers of people flock to this campground especially during holiday weekends to camp, fish, and backpack. This campground has sealed-vault outdoor toilets, however no running faucet water is provided for camper use, although hydrants are located in the area.

Site 3A - Site 3A, at approximately 3125 m (10,440 ft) elevation, is located at the spillway from Brainard Lake. On Brainard Lake, fishing, boating, and swimming are major activities. Two major watersheds (Isabelle and Mitchell-Blue Lake) drain into Brainard Lake. Samples were collected from the stream immediately below the lake's spillway. Moderate algae growth is found along the stream sides in this location. Stream discharge was measured at the spillway of Brainard Lake close to Site 3A.

Site 3B - Site 3B is located on Mitchell Creek at 3125 m (10,440 ft) elevation as it enters Brainard Lake, draining the Mitchell Lake and Blue Lake

Watershed. Although little evidence of recreational activity is present in the immediate area, the watershed above does receive a large number of hikers, backpackers, fishermen, etc., some of whom have dogs on leashes. There is obvious trampling and soil erosion along the shores of Mitchell Lake and Blue Lake. The U.S. Forest Service is initiating an effort to revegetate these heavily impacted areas. There is a moderate amount of algae growth along the stream bed at Site 3B. Stream discharge was also measured at this site.

Site 3C - Site 3C, on South St. Vrain Creek, is located near the stream inlet to Brainard Lake at 3125 m (10,440 ft) elevation. The stream drains the watershed of Long Lake and Lake Isabelle, originating at the Isabelle glacier. Recreational activity is extremely heavy within this watershed. Large numbers of hikers, backpackers, campers, etc. (many with dogs on leash) walk the trail through this watershed, towards Pawnee Pass on the Continental Divide. Impact along the lake shores and stream banks is so drastic that measures are being taken by the U. S. Forest Service to revegetate the trampled areas. Stream discharge was measured at Site 3C.

Site 3D - Site 3D, at approximately 3160 m (10,560 ft) elevation, is located at the stream inlet above Long Lake, near a foot bridge. Recreational activity at this site includes hiking traffic over the bridge and fishing. Additionally, frequent visits are made to the stream side by hikers to get drinking water but erosion by this activity at the stream side is not great.

Site 3E - Site 3E is situated at the lake side of Lake Isabelle, at 3250 m (10,860 ft) elevation. Although the main trail towards Pawnee Pass is well above this site, many hikers and campers choose to go to Lake Isabelle for a campsite. Recreational activity includes fishing, occasional swimming, dishwashing and general camping activities. The lake shore is both muddy

and gravelly, contributing to an increase in suspended and dissolved solids within the water. Lake Isabelle is used as a water source by the City of Longmont and the lake level fluctuates according to releases to that city.

Site 3F - Site 3F, at 3570 m (11,920 ft) elevation, is located in the stream immediately below the Isabelle glacier. Although hikers reach the general area to view the small glacier, little activity is seen in or near the water. This site is therefore considered to have relatively clean, non-impacted water.

4) Middle St. Vrain - The Middle St. Vrain stream, originating from glacial meetwaters, flows through two large campgrounds; Camp Dick at 2590 m (8,640 ft) elevation and Middle St. Vrain campground at 2560 m (8,540 ft) elevation. This study area is heavily used by all types of recreationists (car-campers, backpackers, hikers, fishermen, horseback riders). It is the only study area where heavy horse traffic, from nearby dude ranches, crosses the stream numerous times. This area was the only campground in which access was available (due to an earlier snowmelt) during the Memorial Day Weekend. Running water in faucets is not available at either campground although hydrants are present and, therefore, the stream is used for both drinking and washing.

Site 4A - Site 4A is located beneath the bridge where Highway 72 crosses the Middle St. Vrain, at 2540 m (8,480 ft) elevation. Both campgrounds are located upstream as well as a few summer cabins. Site 4A encompasses all the pollutants from the upstream recreational activity.

Site 4B - Site 4B, immediately upstream from the summer cabins, yet below the campgrounds, was sampled in order to determine the amount of pollutants coming from these second homes. The cabin originated pollutants could

then be isolated from samples taken at Site 4A. Site 4B is located at 2550 m (8,520 ft) elevation. The stream sides are very soft and marshy at this location.

Site 4C - Site 4C, at approximately 2560 m (8,540 ft) elevation, is located immediately below the Middle St. Vrain Campground. There is a great deal of recreational activity within the stream at and above this site, including swimming, dishwashing, fishing, etc. The dirt road to the campground crosses over the stream at this point.

Site 4D - A sign labeling the stream as the Middle St. Vrain, designates Site 4D at 2575 m (8,600 ft) elevation. Site 4D receives recreational pollutants from the Camp Dick Campground upstream. The stream passes through a willow thicket upstream from this site and pollutants may be filtered out to some extent. Recreational activity is minimal due to a steep boulder slope leading to the stream.

Site 4E - Site 4E is located at the second bridge on entering the campground of Camp Dick. There is extensive recreational activity at and around this site, including wading, fishing, washing, etc. The stream banks show much erosion due to trampling and denudation of the ground cover. Site 4E is at 2590 m (8,640 ft) elevation.

Site 4F - Site 4F, upstream from Site 4E is slightly above Camp Dick, but is heavily populated by campers who prefer to be out of the immediate campground. Site 4F receives pollutants from all forms of recreation which occur upstream. Horses cross the stream several times a day above this site along a road which also is traveled by four-wheel drive vehicles, hikers, and backpackers. Site 4F is at 2610 m (8,720 ft).

Methods

Field Measurements

Water samples were taken at midstream and integrated over the entire depth of the stream. The samples were collected in sterile polyethylene bottles and each bottle was properly labeled and placed in an ice chest for transport to the laboratory. Samples were refrigerated at the lab and tested within six hours of collection.

Stream discharge, defined as the volume rate of flow of the water including any sediment or solids that may be dissolved or mixed with it (Buchanan and Somers, 1969), was measured for at least one location at each study site. The stream discharges were measured above any tributaries. Dimensions of stream discharge are expressed in both cubic feet and cubic meters per second.

The discharge measurements involved cross-section measurements of the stream to determine partial areas (depth times width) times the velocity of each partial area. Discharge was calculated by the formula $Q = \Sigma(A_i v_i)$, where Q is the total discharge, A_i is an individual partial cross-section area, and v_i is the corresponding mean velocity of the flow normal to the partial area (Buchanan and Somers, 1969).

The velocity of the flowing water was measured using a current meter at sites where the stream was deep enough for the instrument to operate. When the stream was not deep enough the float method was used. With this technique, a float was placed in the water and its rate of travel downstream was timed. This time was multiplied by 0.60 to convert the higher surface velocity to give the average velocity (in water less than 1.5 feet depth). A headrod was also employed to measure the velocity when the water was too shallow for use of a current meter.

Because of the time required to conduct the stream discharge measurements, these measurements were made either the day before or the day after the water samples were collected.

Water temperatures were measured at each sampling site using a mercury thermometer and pH was determined using pH paper. Precipitation and air temperature data were acquired from the climatological data collected at the Mountain Research Station. Recreational activity and sources of pollution were closely monitored during both heavy and light periods of activity. Head counts, car counts and activities related to stream water quality changes were cataloged.

Sampling took place routinely twice every week for bacteriological properties. During periods of heavy recreational activity, (i.e. weekend holidays such as July 4th, Memorial Day and Labor Day) samples were collected more frequently, and, in addition, were tested for chemical properties. During these periods of frequent sampling, sampling began 2 days before the holiday period and continued 2 days after the holiday period. The time of sampling was between 1300 and 1500 hours. Because of the time involved in the analysis of the chemical properties, these tests were made only 2 to 3 times during the holiday period.

Occasionally, a site was sampled every hour or two hours to determine at what time of the day a peak of pollutants might be detectable.

Additionally, during one intense rain storm, run-off from the campgrounds was collected for bacteriological analysis. The unusually dry summer of 1980 prevented the use of this sampling more than once.

Vegetation Analysis

Using quadrant sampling, 10 square meter plots were established on each side of the stream at each specific study site. Vegetation percent cover was determined at each site. Additionally, the vegetation cover along the length of the streams was determined using 10 square meter plots along the stream channel.

Laboratory Measurements

Bacteriological tests for fecal coliform and fecal streptococcos were performed in the water quality laboratory at the Mountain Research Station (MRS) within 4-10 miles of the study sites. Additionally, tests were made at the MRS for total dissolved and suspended solids. Methods used followed those recommended by Howard L. Gary of the Rocky Mountain Forest and Range Experiment Station, and as outlined by the Milliport Corporation and in Standard Methods (1975).

Samples were transported to the Civil Engineering water quality laboratory at Boulder to be tested for the following parameters: COD, BOD, nitrogen and phosphorus compounds, grease, oil and lead.

Data Analysis

Data was analyzed for central tendencies (mean, median, and range) for routinely collected samples. Extremes are analyzed for those samples collected during periods of high intensity recreational activity. The data is tested by the "t" test for significance. Paired differences were calculated for samples collected during high and low periods of recreational activity and for samples collected at differing sites.

Figure I. Location of study sites for water quality sampling, Front Range, Colorado

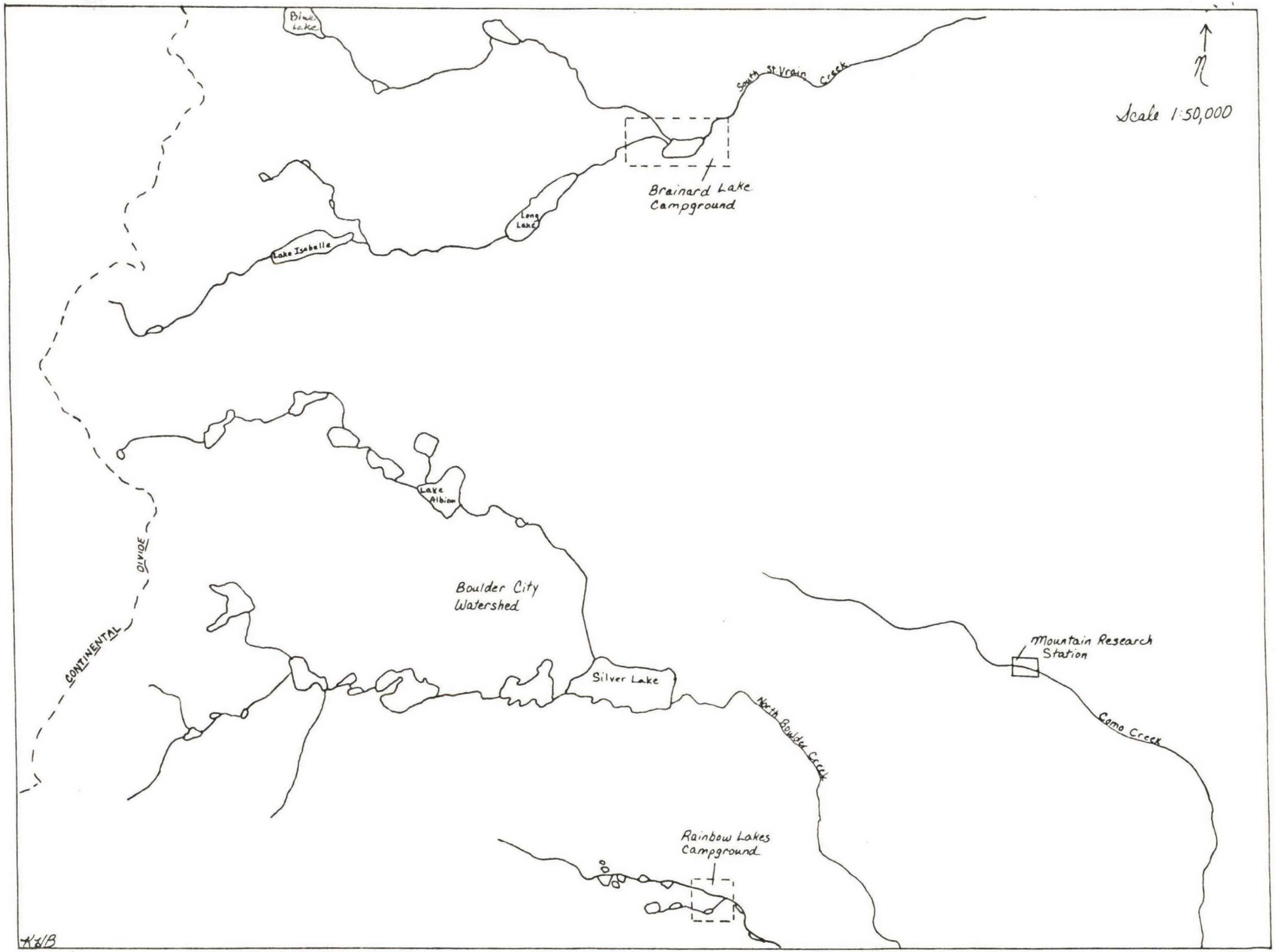
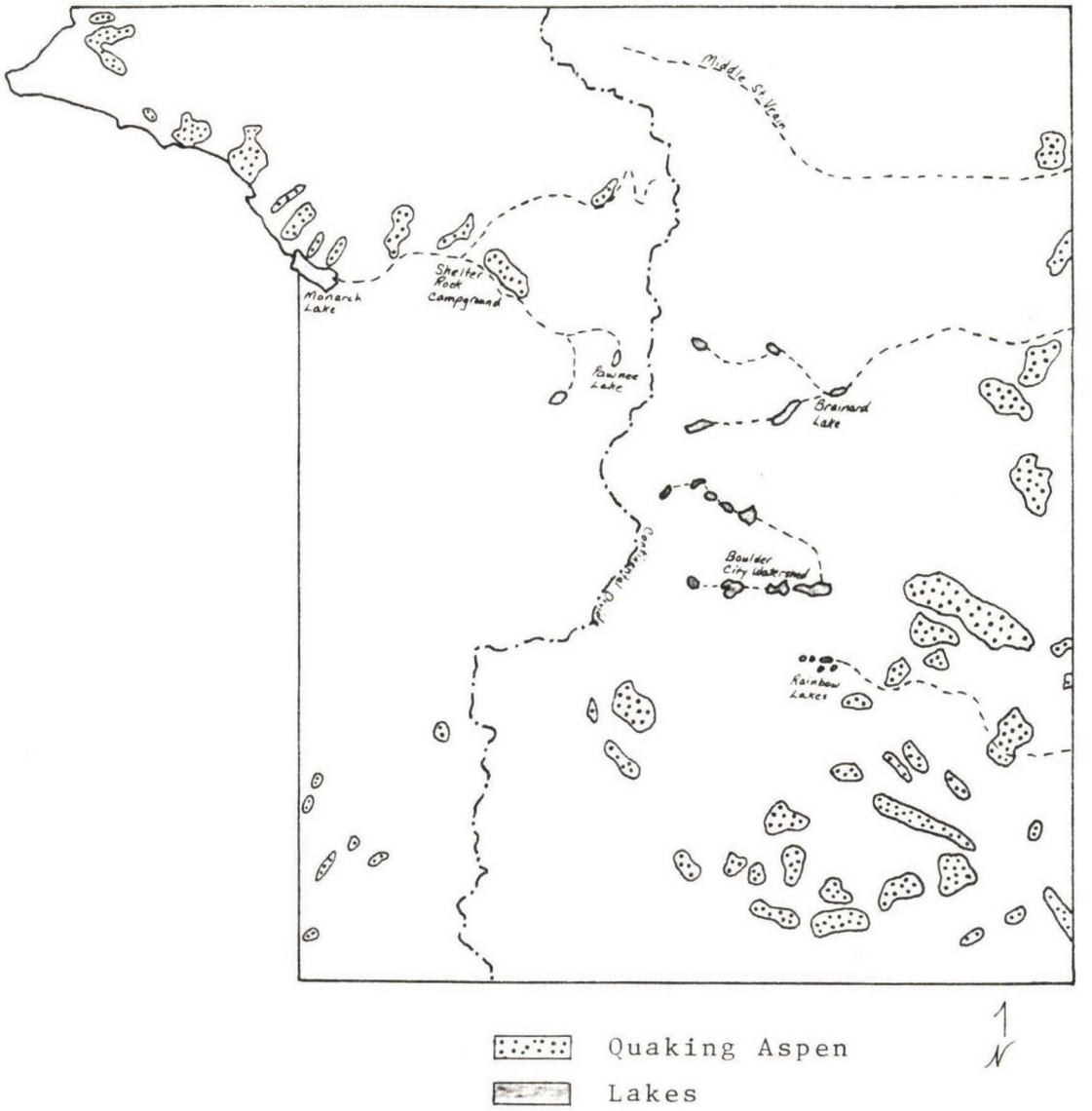


Fig. 2

Distribution of Quaking Aspen (Populus tremuloides) Communities within the Indian Peaks Study Area



LEGEND FOR VEGETATION COMMUNITY MAPS OF MIDDLE ST.VRAIN, BRAINARD LAKE, RAINBOW LAKES, AND THE BOULDER CITY WATERSHED STUDY AREAS

1 Carex-Elephantella Meadow

2 Dry Golden Banner-Yarrow Meadow

3 Moist Alpine Avens Alpine Meadow

4 Moist Alpine Avens-Kobresia Alpine Meadow

5 Dry Rocky Alpine Avens-Kobresia Alpine Meadow

6 Dry Kobresia Alpine Meadow

7 Dry Carex-Kobresia Alpine Meadow

8 Dry Alpine Rock Moss Campion-Sedge Meadow

9 Sphagnum-Willow-Birch Community

10 Moist Willow Community

11 Dry Rocky Willow Community

12 Bare Rock and Snow Banks

13 Bare Rock and Sparse Alpine Vegetation

14 Sparse Forest: Rock Coverage greater than 50%

15 Quaking Aspen

16 Engelmann Spruce-Subalpine Fir Forest

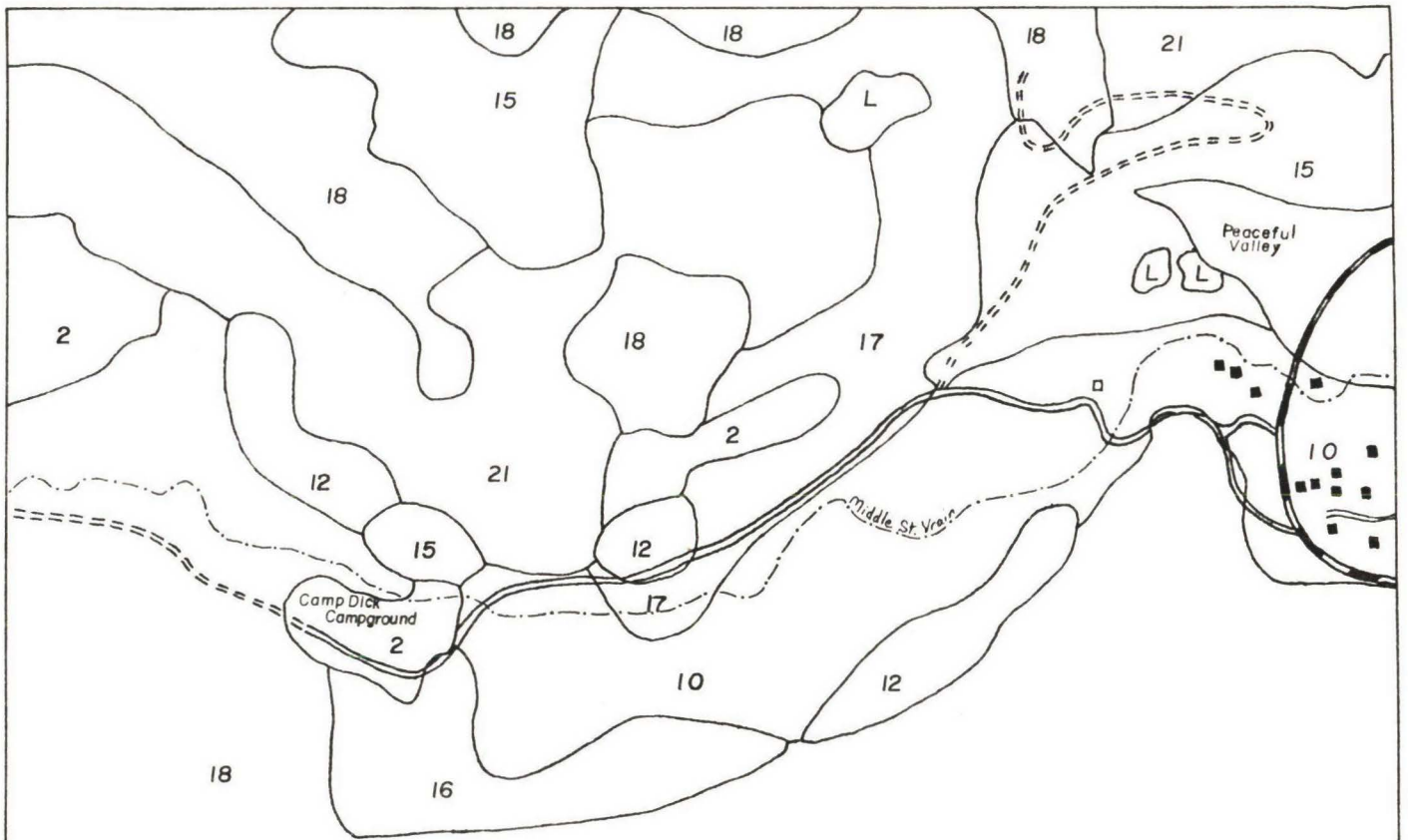
17 Limber Pine Forest

18 Lodgepole Pine Forest

19 Mosaic of Krummholz and Alpine Meadows

20 Disturbed Soil and Rock

21 Ponderosa Pine Forest

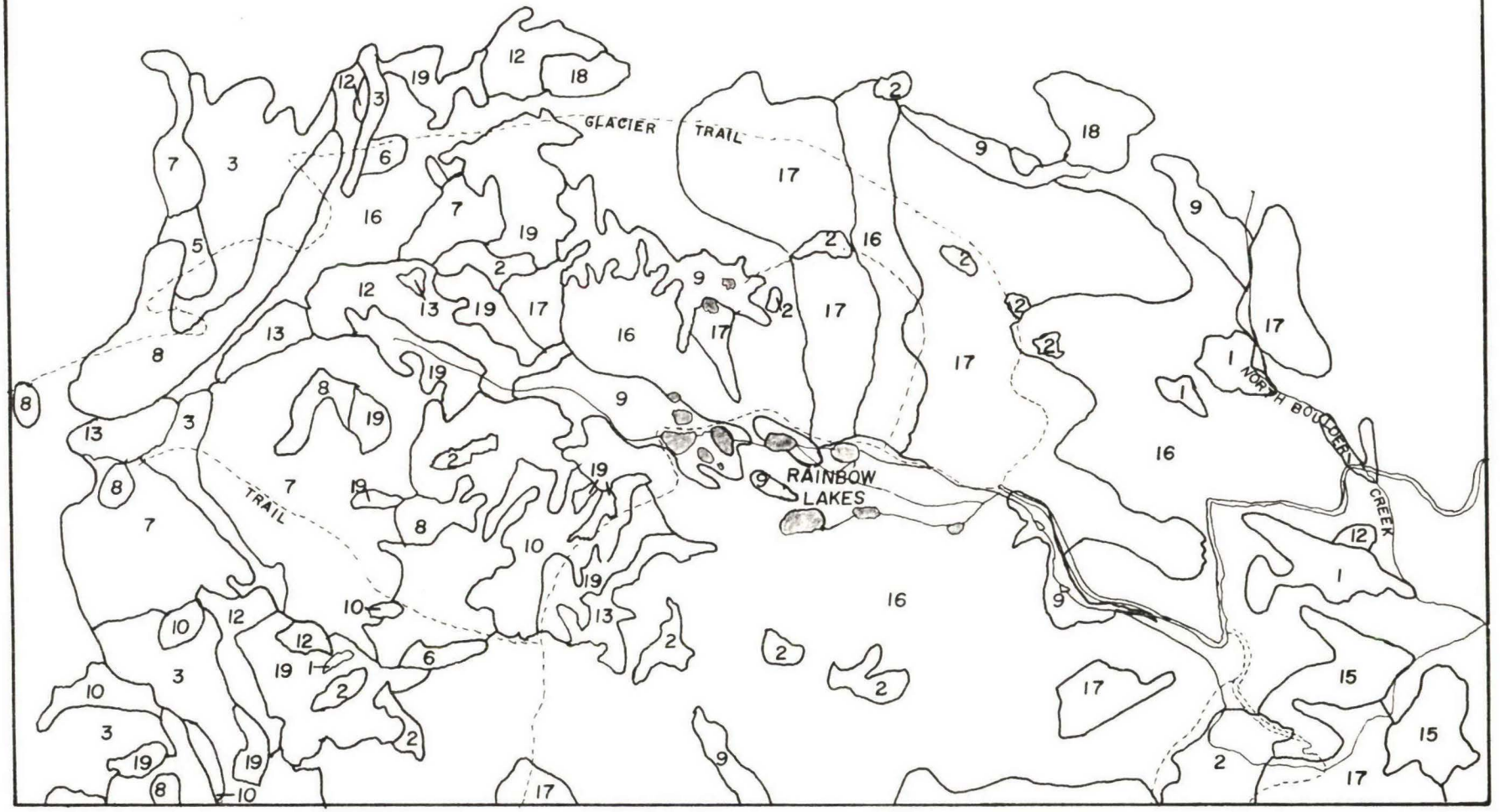


Vegetation communities of the Middle St. Vrain Study Area
Scale 1:12,000

Fig. 3

Fig. 4. Vegetation of the Rainbow Lakes Study Area

Scale 1:24,000



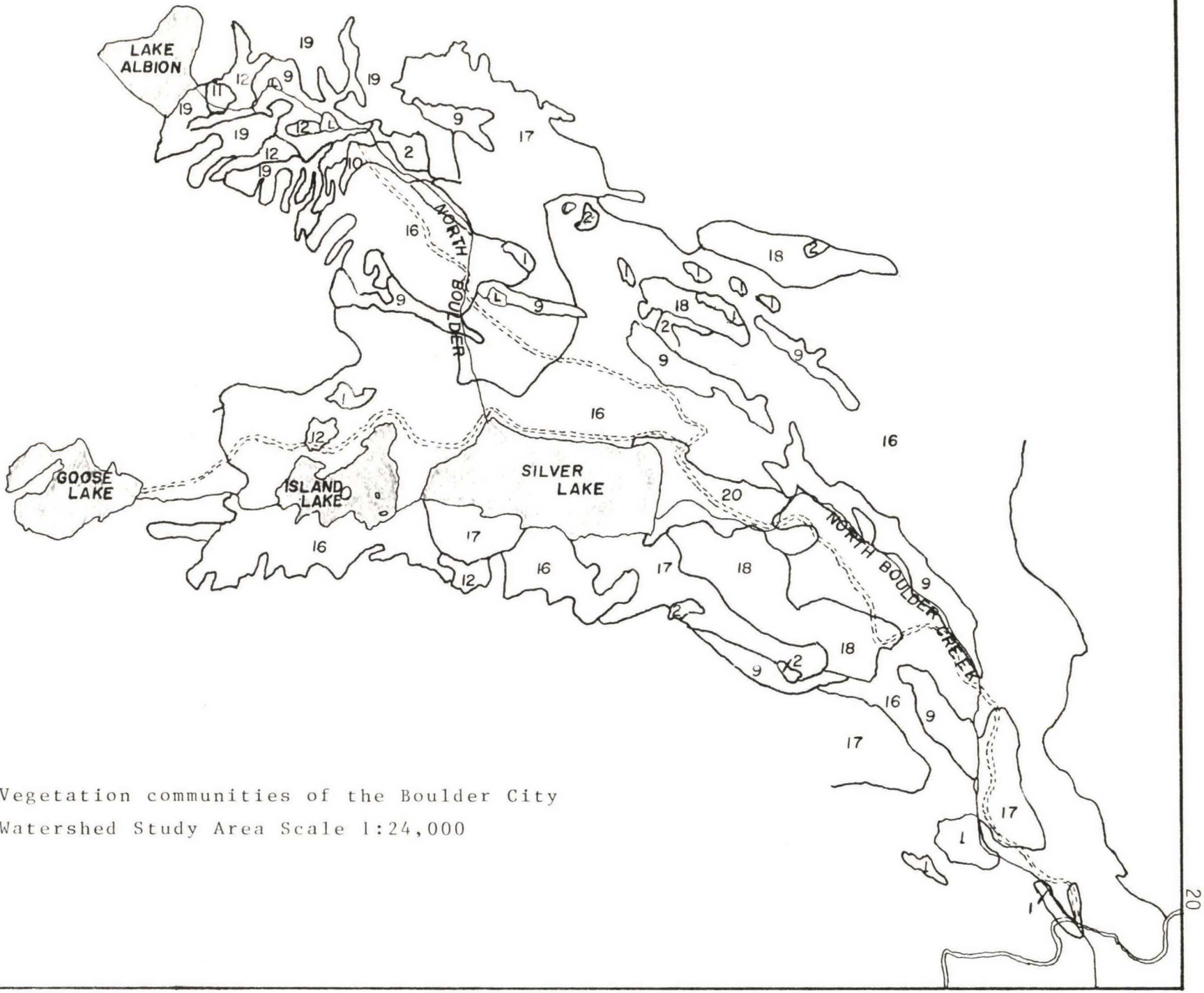


Fig. 5 Vegetation communities of the Boulder City Watershed Study Area Scale 1:24,000

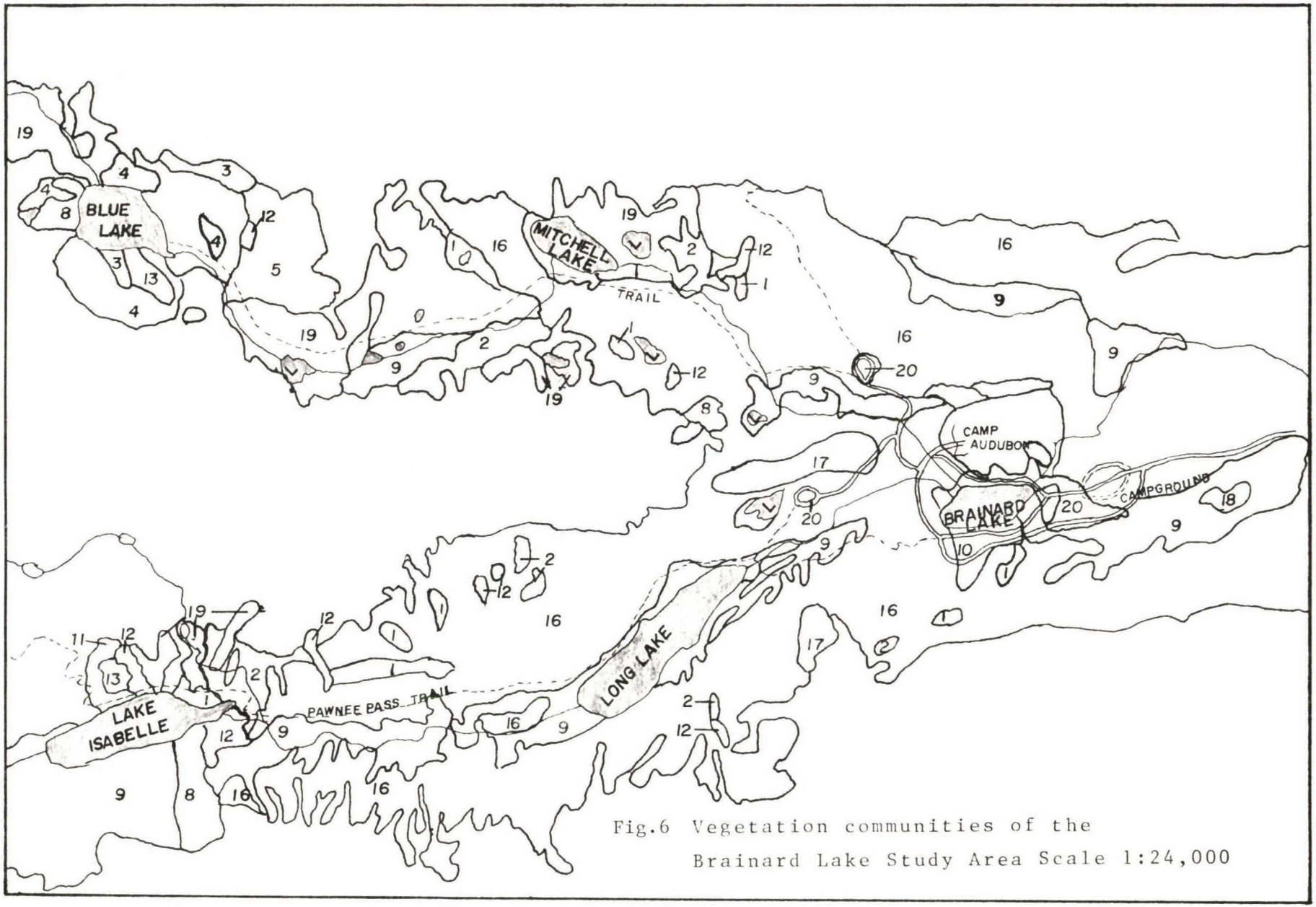


Fig.6 Vegetation communities of the Brainard Lake Study Area Scale 1:24,000

Table I: V[illegible]ation Coverage at Water Sampling Sites (%) (2 [illegible] plots)

Vegetation Site	Quaking Aspen	Engelmann Spruce	Subalpine Fir	Lodgepole Pine	Willow, Birch, Alder, Shrubs	Herbs, Forbs, Grasses	Bare Soil	Rock
1A			10		68	7	6	7
1B	9	2	7	7	25	17	6	27
2A	10	2	2	5	5	20	70	10
2B					40	50	20	
2C					15	10		70
2D					70	10	10	30
3A		10	15		28	12	13	20
3B				5	13	21	28	20
3C		15	15		3	21	19	31
3D		12	11		41	2	6	75
3F					30	35	5	40
4A	7	20	15	2	25	2	13	15
4B	1		4		30	39	16	10
4C		10	25	5	29	13	5	4
4D		10	9	2	13	49	14	15
4E		15	12	3	32	4	33	25
4F	5	10	20		7	50	10	10

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Chapter 2

RECREATION ACTIVITIES

by Anne Ketchin

I. Introduction

The goal of this part of the project was to discover the ways in which recreationists interact with water during their stay in the campgrounds and the wilderness area.

The approach taken relied heavily upon direct observation of people interacting with the streams and lakes. A standard pre-coded observation form was used to maintain consistency in the observation process. This form indicated which aspects of the environment and the behavior were to be noted. In addition, the number of cars (in parking lots and at camping sites) and the numbers of people encountered on the trails and at streams and lakes were tabulated. Weather conditions for each observation day were recorded, as were any changes in weather as the day progressed.

Observations began on Memorial Day weekend, in the Camp Dick and Middle St. Vrain Campground area. The other two areas - Rainbow Lakes and Brainard Lake - were not open to campers because of snow. Observations began at the Brainard Lake area on the first weekend in June, and at Rainbow Lakes on the second weekend in June. Observations continued on weekends through June and July. Some observations were made on five days in August and additional observations were made over the Labor Day weekend.

Observations were made as follows for 20 days of observations.

Five Days

Rainbow Lakes Campground

Rainbow Lakes #1, #2, #3, #4, and the snowfield

Nine Days

Brainard Lake

Long Lake

Isabelle Lake

Mitchell Lake

Blue Lake

Six Days

Bridge above Camp Dick

Camp Dick

Creek above Middle St. Vrain (MSV) Campground

MSV Campground

For purposes of this section the sites in the study have been combined. For instance, all sites in the Brainard Lake area are referred to under that general heading. The number of individual activities observed were as follows:

Site	Activity Observations
Rainbow Lakes Area	177
Brainard Lake Area	333
Middle St. Vrain Area	239
Total Number of Activity Observations	732

The strategy used to obtain the maximum number of observations possible was to enter the study area early in the morning, observe the concentration and distribution of people by walking through the area and then choosing a specific site to observe. In this way the most intensely used areas could be identified. Because the distribution of use usually changed as the day

progressed, it was necessary to re-check the activity in other parts of the site and move to the most active area, if necessary.

In the study areas which had lakes, the most activities invariably were on a lake shore where people congregated. In the two areas which have intensely used creeks, observations were made by walking back and forth along the creek. Much activity did occur along the creeks, but because of trees and underbrush, some activities were hidden from view and it was necessary to constantly patrol the area. At locations where both lakes and streams were actively utilized a choice had to be made to observe activity at one or the other.

Even with constant patrolling, many activities would be missed, and only indirect evidence of them remained. Activities such as hand-washing last only a few seconds, and can go unrecorded. This situation was especially prevalent in the Middle St. Vrain area. There are no lakes there and the stream invites activity for a distance of at least two miles. Campers and anglers spread out all along this distance, and although water-related activity is intense, it is difficult to observe.

For these reasons, as the study progressed strategies evolved which differed from area to area. In the Middle St. Vrain area time was divided between patrolling the creek, noting in detail direct and indirect evidence of relevant activity, or staying on or near the two bridges that cross the creek. One of these bridges is in the middle of the lower campground, and the other is at the entrance to Camp Dick. Both invite water-related activities.

In the Brainard Lake area, lakes were the focus of attention. Activities were observed with the aid of binoculars, all around the lakes. This aided

in the observation process because it called less attention to the observer and allowed people to continue their activities without interruption.

In the Rainbow Lakes area the lakes are some distance apart. In addition, the creek flows through the campground which is some distance from the lakes, but observations there are desirable. Camping and intense use prevails around and above the lakes. Horses are sometimes used, although none were observed in this study. Lake #2 seemed to be the best place to observe lake shore activity. Each day was divided between observations at Lake #2 and in the campground itself.

In each of the study areas the upper trails leading from the campgrounds were walked for a distance of at least one mile each observation day. Often the distance was farther than this.

Sixty-five of the 732 observations were made by assistants during August who varied in their observations from the strategy described above. Their observations were made on "diurnal" days, when water samples were taken at the same location at specified times over the entire day. In between sampling times the assistants made observations for that particular location. The assistants did not record weather conditions, numbers of people on trails, or the numbers of cars.

II. INTENSITY OF USE

The Sulphur District Office of the U.S. Forest Service has compiled user numbers in each area. This was done by means of a car counter on the Brainard Lake entrance road that operated from July 4th until after Labor Day. Electronic trail counters were in operation on the Long Lake trail and the Mitchell Lake trail. Counters were also in place at times in the Rainbow Lakes area, and the Middle St. Vrain area.

Recreation - Activity Observations

Date	Rainbow Lakes (RBL)
6/21	29 vehicles parked at trailheads and along road. Campground 3/4 full. 54 hikers on trails.
Weather:	Clear, warm, summery
6/22	Approximately 50 hikers. Campground 3/4 full.
Weather:	Clear, warm, summery
7/6	About 70 hikers. Campground 3/4 full. About 30 vehicles at trailhead & along road. Camping along creek below campground down to second meadow on Caribou Ranch Road.
Weather:	Clear, hot
8/31	13 of 16 sites occupied at 9 AM. Parking 1/2 full. 10 people average at Lake #2 all day. 25 people on trails at 12:15 (no backpackers).
Weather:	Sunny, windy & cool in AM, cloudy & windy in PM.

Date	Brainard Lake (BL)
6/8*	Approximately 50 vehicles at the road closure (10 am). Approximately 50 people on trails.
Weather:	Cool, partly cloudy breezy in AM, chilly and cloudy in PM.
6/28**	84 vehicles on road at 10 AM, 148 at 5 PM. 129 hikers, 30+ people around B.L.
Weather:	Cool, sun in and out, windy
6/29	50+ people around B.L. 80 vehicles along road. 50 more at Left Hand road which is closed. 100+ people on trails.
Weather:	Clear, warm, few clouds
7/4	Campground & picnic areas overflowing. Vehicles all around lake. Long Lake lot full. Mitchell Lake lot 3/4 full. All overnight parking full. 200 people around B.L.
Weather:	Warm, clear, some wind in PM and cooler.
7/13	All parking lots full; campground full. Encountered 170 people at Lake Isabelle.
Weather:	Cold, windy, periodically overcast, light rain

Date	Middle St. Vrain (MSV) and Camp Dick
5/31	MSV campground full. Camp Dick empty because road closed.
Weather:	Cold, cloudy, windy
6/7	Camp Dick full and overflowing up the stream to the first meadow, MSV. Campground full.
Weather:	Cool, sunny morning, cloudy PM
7/5	Both campgrounds full & overflowing. Camping extends to first meadow above Camp Dick and all along stream and road between campgrounds. Picnicing heavy along road. Traffic heavy, noisy and dusty.
Weather:	Warm, calm, clear
8/30	Campgrounds full at 10 AM. Lot above Camp Dick and camp sites along creek below Camp Dick not full. Camps above Camp Dick full. Constant traffic all day.
Weather:	Cold, partly cloudy, breezy in AM. Occasional sun, rain and windy in PM.

7/20	Mitchell Lake trail-head lot 3/4 full. All other camping & lots full. 235 people at Blue Lake.
Weather:	Breezy, warm & clear AM; cloudy in PM with wind, cold at times

*Road to Brainard Lake closed at Left Hand Reservoir Junction due to snow drifts.

**Road officially closed but gate left open accidentally on Saturday, June 28, allowing cars in as far as they could get; most got to last curve before campground. On June 29 road was re-closed but 80 cars remained.

Figure 6 Estimated Summer Activity Cycle

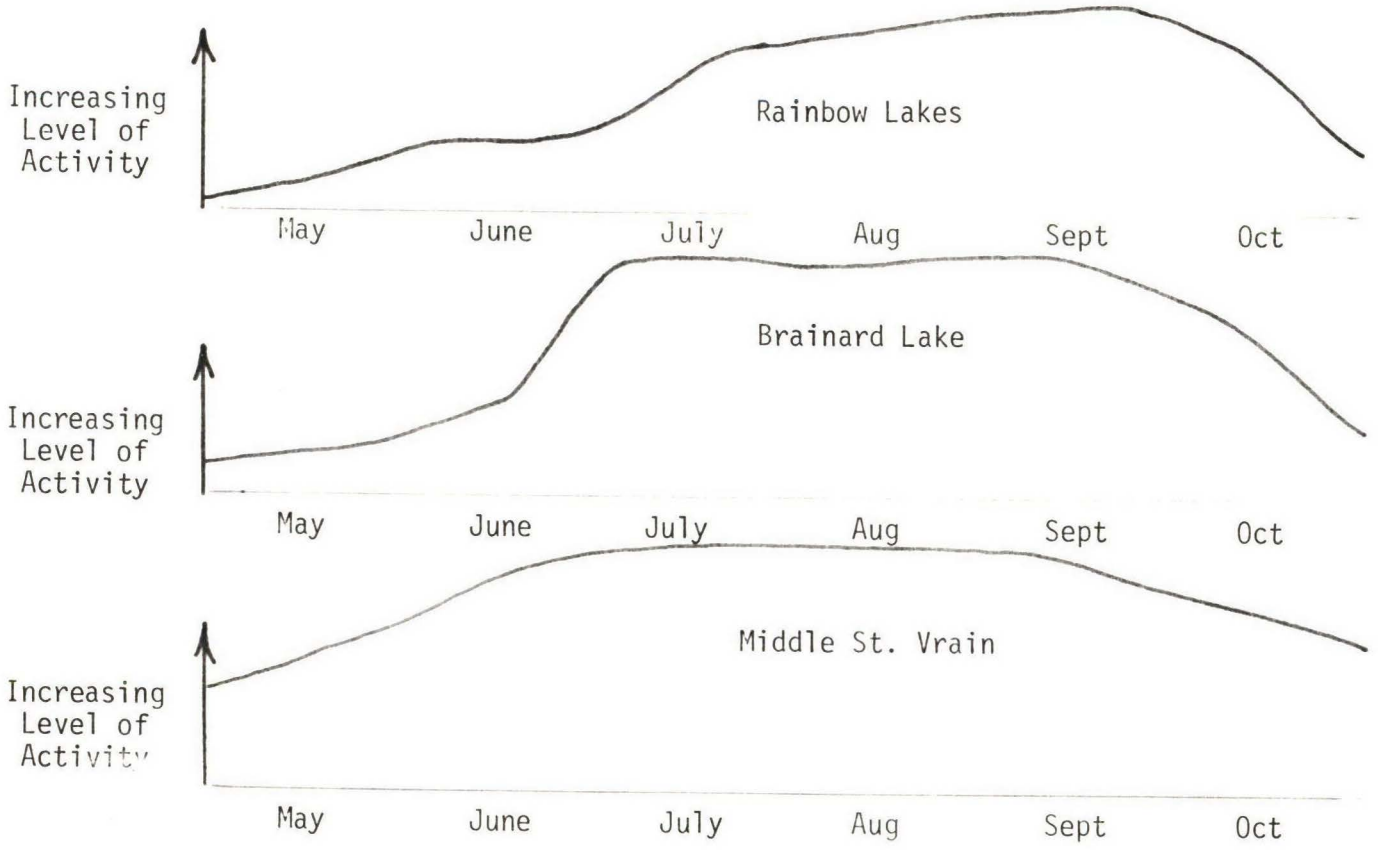

Table 2

FREQUENCIES OF WATER RELATED ACTIVITIES

	Number of Direct Observations			Number of Indirect Observations			
Area Activity	Brainard Lake	Rainbow Lakes	Middle St. Vrain	Brainard Lake	Rainbow Lakes	Middle St. Vrain	Totals
Swimming	2	1					3
Washing Clothes		2				1	3
Fishing	80	29	37	52	59	17	274
Brushing Teeth		3	7			1	11
Wading	27	9	20		1	1	58
Drinking	1		1				2
Playing	47	6	29		3	2	87
Cleaning Fish	3	7		8	8	21	47
Dog in Water*,[a]	13	3	2	7	10	2	37
Washing Self	7	3	9	1	1	3	24
Throwing**	23~	6~	11~	24~	13~	45~	119~
Boating	10						10
Other	18	1	2		1	4	26
Humans Relieving Themselves	1		7	4	2	6	20
TOTALS	235	79	134	98	98	105	732

*Each incident repeated at least five times. **Incidents repeated all day. [a]Numerous dogs observed unleashed on trails.

Table 3

FREQUENCIES OF OBSERVED AND DEDUCED CONSEQUENCES

	Number Observed			Number Deduced			
Area Consequence	Brainard Lake	Rainbow Lakes	Middle St. Vrain	Brainard Lake	Rainbow Lakes	Middle St. Vrain	Totals
Food	14	4	11	12	2	7	50
Soil	10	11	10			7	38
Soap/ Detergent	5	2	6	1	3	15	32
Dust in Air			~21				~21
Ash/Soot/ Charred Material	2	6	14		1		23
Organics, i.e. wood, leaves	22	2	8	23	1	6	62
Oil	4						4
Bait	16	9	7	24	5	9	70
Animal Remains	10	8	22		1		41
Disturbed Banks	75	29	13	55	9	23	204
Trash	49	20	55	1	7	3	135
Human feces, Urine				1	2	13	16
Animal Feces, Urine				11	3	2	16
Toothpaste		2	7				9

Table 3 (Continued)

	Number Observed			Number Deduced			
Area	Brainard Lake	Rainbow Lakes	Middle St. Vrain	Brainard Lake	Rainbow Lakes	Middle St. Vrain	Totals
Consequence							
Human Saliva			7	1	2	1	11
Animal Saliva				10	4	2	16
Other Organics				12	4	4	20
Other Inorganics							
TOTALS	207	91	181	151	44	92	768

MOST FREQUENT ACTIVITIES

Throwing	119 (too numerous to count)
Fishing	274
Playing	87
Wading	58
Washing	59 (all kinds)
Cleaning fish	47
Dog in water	37

DAILY PEAK IN VARIOUS ACTIVITIES

Throwing	11:00 a.m. - 5:30 a.m.
Fishing	11:00 a.m. - 2:00 p.m.; 4:00 p.m. - 6:30 p.m.
Playing	10:00 a.m. - 4:30 p.m.
Wading	11:00 a.m. - 4:00 p.m.
Washing	8:00 a.m. - 10:00 a.m.; 4:00 p.m. - 6:00 p.m.
Cleaning fish	4:00 p.m. - 6:30 p.m.

Interaction with the water is highly responsive to the weather changes. For instance, at Lake Isabelle on July 13th there were 170+ people at the lake between 10:30 a.m. and 2:30 p.m., although the weather was periodically cold, windy, and rainy. These people sat and looked at the lake, and/or sought shelter among the flag form trees and krummholz, but very few of them actually approached the water, much less did anything with it. In the Middle St. Vrain area on cloudy, windy afternoons people disappeared inside their campers, or hiked in the trees, but stayed away from the water.

ACTIVITIES MOST LIKELY TO POLLUTE WATER
(Based on Consequences Table 3)

Wading, Throwing, Playing, etc.	Disturbance of bank, organics thrown into water, stones taken from bank, running in and out of water, etc.

Fishing	Bait, fish entrails, disturbance of bank, trash. Song birds were found with hooks in their throats, line trailing from the hooks, and entangled in their wings, with hooks in their wings, and line entangling them in the willows. These birds could not be helped. Fishing was observed all along shores and banks.
Dogs in and out of the water	Dog hair, possible feces and urine, organics thrown for the dog to fetch, disturbance of bank, etc.
Car Camping in RBL and MSV study areas (no running water).	Washing of dishes, bathing, clothes washing, brushing teeth, food, soap, ash, soot in water, disturbance to bank, etc.

Information obtained from Forest Service personnel is that they clean lakes and stream banks whenever they can, especially during the week. They pay particular attention to the Brainard Lake area.

The numbers on the frequency of consequences table do not equal those on the frequency of activity table because of the manner in which the two kinds of data were recorded. Because one person or group of people being observed would engage in more than one activity, or sometimes simultaneously, these different activities would be recorded on the same observation form, and kept distinct from each other. However, the activities would often have similar or identical consequences and, therefore, the consequences would be recorded fewer times than the activities which produced them. For future research the observation form could be altered to take this into account.

Micro-Environment

While the locations of activities were recorded in an effort to discover if vegetation guided recreationists' choices of sites and of activities, few patterns emerged which related strictly to the environment. The most salient was how wet and soggy the ground was near the water.

Other factors, not environmentally related, guided the choice of location. Access was the crucial variable. When there was easy access to a lake shore, it was used with the heaviest use being nearest the access. After that, vegetation and weather began to have some impact on which spots people chose. If a lake was crowded, all but the wettest areas would receive intensive use. As the number of people decreased, certain kinds of location began to drop off in usage. These relationships are depicted by the charts which follow.

Choice of Location

The behavior of recreationists in their choice of location for recreation depends on the following variables. The number of people using the location, i.e. a lake or campground, etc. depends on:

1. Ease of access
2. Wetness
3. Degree of crowding
4. Weather

where: Access refers to how near the location is to a road or parking lot, as well as local access such as the steepness of a creek bank.

Wetness refers to the degree to which the ground is saturated at the specific location.

Degree of crowding refers to the number of people using the general site (lake, campsite, etc.).

Weather refers to temperature, amount of wind, precipitation, sun, etc.

All of the study areas can be classified as having easy access in the context of a wilderness. People can drive right to the campgrounds, and to within a few minutes walk of nearly all the lakes and streams. Some loca-

tions, however, have easier access than others. For instance, Brainard Lake has a paved road all the way around it. The Middle St. Vrain Campground is a few hundred yards from a major highway, and a dirt road in good repair leads from it up the creek for about a mile, ending in the Camp Dick Campground. From there a four-wheel drive road follows the creek for another four miles.

The Rainbow Lakes Campground is accessible over a very rough unimproved road. The creek flows right through the campground. The Rainbow Lakes themselves lie in a string along a wide, eroding trail above the campground. The first lake is a five minute walk from the campground, and many people carry ice chests, cases of beer, and other picnic items to it and to Lake #2, about three minutes farther. Lakes 4 and 5 are only a few minutes beyond that. For the purposes of this discussion, a continuum from easy to difficult access has been used and refers to the various lakes, streams, and camp sites in the following manner:

Easy Access - Brainard Lake, Middle St. Vrain Campground, Camp Dick, MSV Creek, S. Boulder Creek.

Medium Access - Rainbow Lakes Campground, Rainbow Lakes #1 and #2, Long Lake, Mitchell Lake, campsites above Camp Dick.

Difficult Access - Rainbow Lakes #3, #4, and #5, Isabelle Lake, Blue Lake.

Only after the above variables and relationships have been considered does vegetation begin to affect people's choices of spots for their activities. First choices are open, grassy banks, gently approaching the water, with conifers a few feet away. Second choices are open conifer forests,

with gentle sloping banks, a few scattered large boulders on the bank and nearby in the water. Dense growth such as willows stops most use, although fishermen penetrate them and move along the shores and banks over well-worn paths. Open understory with relatively dry grassy banks near water invite use. They provide the grassy areas which are popular, but also offer shelter should the wind come up.

The places most often chosen, all else being equal, were readily accessible, dry grassy banks of streams and lakes, with conifers or small trees nearby for shelter. Ideal spots may include a large boulder or two a few feet out in the water. These were the spots first chosen. As the number of people increases, less and less ideal spots will be chosen, the last being the wet ones, regardless of grass or trees nearby. These spots get a lot of traffic through them, regardless of degree of crowd, but few people remain until other spaces are full. In very intensely used areas, such as the shores of Brainard Lake, even the wet places are used, mostly for fishing, as people try to place some space from each other. Also, as the season progresses and the wet spots dry out, more and more use occurs there.

Shallow water invites more use than deep water. Slow water invites more use than fast water. Bridges, adjacent roads, and dams invite intense water-related activity.

Unfortunately, although there are aspen stands in or near some of the study sites, there were virtually none in the observation areas. Therefore, it was not possible to observe people interacting with water among the aspen. Based on the observations, however, it is surmised that people would avoid aspen groves that are dense and have moist soils if other

choices were available. However, the intensity of use observed in the willow shrub areas suggests that access is the most important determinant of use with degree of crowding closely following. Dense and wet willow-shrub areas around Brainard Lake, Long Lake, and around the Rainbow Lakes are used regularly despite their wetness, and show marked impact on the vegetation and soil. These places are readily accessible and paths through them are well-worn. The competition for space around the lakes, and the prevalence of children and fishermen leads other people to make use of them. If there were aspen stands in these areas, the same situation would no doubt be found.

CONCLUSIONS

It should be emphasized that the conclusions here must be considered preliminary, and subject to verification in future studies. The numbers of people visiting the three study areas each season exceeds 30,000. The number of observations possible given the time and manpower constraints of this project was limited to 732 total. This number provides solid evidence for the viability of the research design, and for the preliminary conclusions presented here.

The most striking single consequence from all the water-related activities observed was the disturbance to the banks of lakes and streams in the form of erosion and trampling of soil and vegetation. The second most striking consequence was the variety of trash and litter in the water near the shores of lakes. This includes food items, fish entrails, bait, paper, wrappers, labels, cans, food, etc. A variety of activities result in these consequences. Fishing, playing and throwing, picnicing, dogs, wading, and using sand and mud to help with dishwashing are the most prevalent. From this it appears that day-use activities could have an impact

on the quality of the water in the area.

From the observations it can be said that with increased recreation use:

1. Factors relating to the disturbance of the banks will increase such as trampling and erosion.
2. Factors relating to disturbance of the natural environment will increase such as disturbance of plants - breaking of tree limbs, movement of rocks, etc.
3. Factors relating to human activity will increase such as dog hair, feces and urine, fish bait, entrails, etc.

The intensity of water-related activity varies closely with the weather. On cold, cloudy, windy days all water activities diminish, and people tend to stay in the trees or behind rocks, or to hike in the forest. Their visits to the water are few and often brief. When the water is interacted with the occasions relate to perceived necessity, such a quick rinse of a hand, or a dish, or the filling of a bottle. If the sun is out, even if there is a cold wind, fishing increases, as do other activities which allow a person to be out of the wind and in the sun. However, contact with the water, or boating, remain low. When there is no wind and the sun is shining all activities increase.

Ease of access and degree of crowding, in close relationship with the wetness control the choice of location for an activity much more than does preference for certain vegetation or micro-environment. Assuming complete freedom of choice it appears that lakes, dams, bridges, and nearby roads draw the greatest concentration of water-related activity. Around a lake, the first sites to be used are those readily accessible which are dry, offer

grassy, open banks, gentle slopes, nearby conifers (open forest or scattered trees). The water at these locations is preferably shallow, still or flowing gently, allowing for wading, and playing. Large boulders a few feet out in the water draw a lot of activity. Conifer/willow mixes are acceptable also, if the ground is dry, and comfortable (grassy or clear of stones).

Given crowding and easy access, recreationists will make use of almost any kind of area, even soggy, dense willow thickets, if there are paths through them. Even large bogs will draw traffic across them, and if crowding is intense enough, will attract fishermen and playing children.

Arizona 1932- 1933
Climatological Data